S8761
C47
R6
No. 77-15

Wayne your copy

# Forest Insect and Disease Management

5230
BIOLOGICAL
EVALUATION R2-77-15

WESTERN SPRUCE BUDWORM

on National Forest Lands
in Colorado

SEPTEMBER
1977

## Rocky Mountain Region

U.S. Department of Agriculture Forest Service

5230
BIOLOGICAL
EVALUATION R2-77-15

# WESTERN SPRUCE BUDWORM

on National Forest Lands
in Colorado

SEPTEMBER
1977

PREPARED BY: James P. Linnane
James P. Linnane
Entomologist

APPROVED BY:

G. L. DOWNING
Staff Director
Forest Insect and Disease Management

F. A. DORRELL
Deputy Regional Forester
State and Private Forestry

Forest Insect and Disease Management
State and Private Forestry
Rocky Mountain Region
USDA Forest Service
11177 W. 8th Avenue
Lakewood, Colorado 80225

## INTRODUCTION

The western spruce budworm is a serious defoliator of Douglas-fir and true firs in the Rocky Mountains. Since the early 1970's, populations of the western spruce budworm have been increasing in the Douglas-fir and white fir forest types along the Front Range of Colorado. During 1976 and 1977, budworm populations reached epidemic conditions. In 1977, heavy defoliation occurred in sections of the Roosevelt, Pike and San Isabel National Forests; aerial surveys indicated over 400,000 acres of defoliation.

In those areas sampled, predicted defoliation in 1978 should be less severe than experienced in 1977, indicating a decline in western spruce budworm numbers.

## TECHNICAL INFORMATION

CAUSAL AGENT: *Choristoneura occidentalis* Freeman, western spruce budworm

HOST TREES: *Pseudotsuga menziesii* (Mirb.) Franco, Douglas-fir
*Abies concolor* (Gord. and Glend.) Linbl., white fir
*Abies lasiocarpa* (Hook.) Nutt., subalpine fir
*Picea engelmannii* Parry, Engelmann spruce
*Picea pungens* Engelm., blue spruce

LIFE HISTORY: The western spruce budworm normally has one generation per year. Moths usually emerge in late July or early August. Shortly after emergence females mate and lay egg masses on needles. The eggs hatch in about 10 days. The larvae do not feed, but seek hiding places among lichens or under bark scales where they spin silken shelters (hibernacula) in which they remain dormant overwinter.

In the spring, the larvae migrate to the foliage where they mine the needles for 1 to 2 weeks. About the time the buds start to swell, the larvae move to the expanding buds. As the new shoots unfurl, the larvae spin loose webs between the new needles, in which they feed until the new foliage is entirely destroyed before

feeding on older needles. Larvae become full grown in 30 to 40 days after attacking the buds. The larvae pupate either in existing webs, or in webs they spin in other areas of the tree. Adult moths are poor flyers, but may be carried great distance by air currents, thereby spreading the infestation.

EGG MASS SURVEY: Forecasts of budworm defoliation are based on densities of new egg masses as determined by sampling a small number of Douglas-fir. Two 24 inch foliated branches are pruned from the midcrown of each sample tree (dominant or co-dominant trees). These foliage samples are bagged, numbered, and transported to a lab for examination. Egg masses are separated under a microscope into new and old categories. Numbers of new egg masses are summarized and the next year's defoliation predictions are made following McKnight's scheme (1970).

In 1977, an egg mass survey was conducted on the San Juan, Rio Grande, Pike and San Isabel, and Arapaho and Roosevelt National Forests between August 8 and September 9.

EXTENT OF THE OUTBREAK: In 1977, an aerial survey found approximately 428,000 acres of national forest lands with some western spruce budworm induced defoliation (Figure 1). The most severe defoliation occurred along the Front Range.

HOST STAND CONDITION: Douglas-fir and white fir stands in the southern Front Range and Douglas-fir stands in the northern Front Range have suffered extensive and occasionally heavy defoliation (up to 100% of the new growth) in 1976 and 1977. Budworm infestations have caused varied amounts of tree deformity, seedling damage, seed destruction, and poor stand regeneration. Stands which have been subjected to more than one year of consecutive defoliation may incur top-killing and a still unknown amount of tree mortality. Radial growth of infested trees will be severely reduced through the duration of the infestation. However, the principle damage caused by the western spruce budworm epidemic in R-2 has been a reduction of aesthetic values within infested zones.

## RESULTS AND DISCUSSION

### San Juan National Forest

An aerial survey revealed 25,600 acres of defoliation. Two areas, Vallecito Reservoir and Beaver Meadows, were ground surveyed to estimate the density of new budworm egg masses. Data are summarized in the following table.

| AREA | Average Number New Egg Masses Per Branch Sample | 1978 Defoliation Prediction |
|---|---|---|
| Vallecito Reservoir | 1.02 | Light |
| Beaver Meadows | 0.55 | Undetectable |

The overall defoliation level in the Vallectio Reservoir area was moderate (35 to 65% of the new growth destroyed) in 1977. The prediction for 1978 is light defoliation (5 to 35% of the new growth). Past evaluations indicate the current infestation began in 1974. Historical evidence indicates the infestation may continue into 1978 and possibly longer.

Defoliation in the Beaver Meadows area was light in 1977. The defoliation forecast for 1978 is undetectable (0 to 5% defoliation of new growth).

### Rio Grande National Forest

A ground survey in the Beaver Creek and Alder Creek area did not detect any evidence of budworm activity. Defoliation in 1977 was undetectable. The forecast for 1978 is undetectable defoliation.

### Pike and San Isabel National Forests

The current budworm infestation on the Pike and San Isabel National Forests appears to have begun in the early 1970's and has been particularly severe in 1976 and 1977. An aerial survey indicated 259,200 acres (27,520 light; 37,760 moderate; and 193,920 heavy) of defoliation in 1977.

San Isabel National Forest: Egg mass surveys were conducted in the Spanish Peaks, Sangre de Cristo Mountains, and the Wet Mountains in August of 1977. Data are summarized in the following table.

| Area | Average Number New Egg Masses Per Branch Sample | 1978 Defoliation Prediction |
|---|---|---|
| Spanish Peaks | 0.50 | Light |
| Sangre de Cristo Mtn. | 1.60 | Moderate |
| Wet Mountain | 0.98 | Light |

Some areas in the Spanish Peaks exhibited heavy defoliation (65 to 100% of new growth) in 1977. The prediction for 1978 is light defoliation in those areas heavily defoliated in 1977 and previous years. However, damage may be more severe in those stands where light or moderate defoliation occurred in 1977.

White fir and Douglas-fir in the Sangre de Cristo Mountains was moderately to heavily defoliated in 1977. The area from Music Pass to Hayden Creek was sampled. The forecast for 1978 is moderate defoliation.

In 1977, the western spruce budworm was very active in the Wet Mountains causing heavy defoliation in the Douglas-fir and white fir forest types. The infestation appears to have peaked in 1977. The prediction for 1978 is light defoliation.

Pike National Forest: The Rampart Range and South Platte River Drainage experienced moderate and occasionally heavy defoliation in 1977. The overall outlook for the Pike National Forest is moderate defoliation in 1978. Data are summarized in the following table.

| Area | Average Number New Egg Masses Per Branch Sample | 1978 Defoliation Prediction |
|---|---|---|
| Rampart Range | 1.72 | Moderate |
| S. Platte River Drainage | 1.23 | Moderate |

Arapaho and Roosevelt National Forests

In 1977, an aerial survey detected approximately 144,000 acres of defoliation (28,160 acres light; 115,840 acres heavy). Since 1973, the Roosevelt National Forest has perhaps suffered the most serious western spruce budworm caused defoliation of any national forest in Colorado. Douglas-fir stands on the Redfeather District and on the Boulder District along Devil's Gulch near Glen Haven, Johnny Park, and in the vicinity of Sugarloaf Mountain were again severely defoliated in 1977.

The forecast for 1978 is a continuation of the infestation at near the 1977 level, possibly with a decline in severity in those areas heavily defoliated in 1976 and 1977. The overall outlook for the Roosevelt National Forest in 1978 is moderate defoliation (Table 1). Some top-killing and tree mortality may be expected in those areas experiencing consecutive years of severe defoliation.

## SUMMARY

The forecast for the San Juan National Forest in 1978 is light defoliation (5 to 35% of the new growth) in those areas surveyed. The western spruce budworm will continue to be undetectable (0 - 5% defoliation) in the Rio Grande Forest in 1978. The San Isabel National Forest suffered moderate (35 - 65% of the new growth) to heavy (65% and over) defoliation in 1977. The overall prediction for the San Isabel in 1978 is a decline in the severity of the infestation in the Spanish Peaks and the Wet mountains, light defoliation is expected, and a continuation of the infestation at moderate levels in the Sangre de Cristo Mountains. The Pike National Forest will experience moderate defoliation in 1977. The forecast for the Roosevelt National Forest in 1978 is moderate defoliation.

## CONCLUSIONS

Historically, the western spruce budworm has reached epidemic proportions at periodic intervals. These epidemic infestations may persist for 2, 3, or more years before returning to endemic levels. During the epidemic period budworm damage may be severe and highly

visible. Presently, resource managers have only two alternatives in managing budworm infested lands. Where management objectives warrant, the first alternative is direct chemical control. The second is to do nothing. Silvicultural management of susceptible stands, often indicated as an important tool in reducing losses to forest insect pests, has not been adequately investigated in the central and southern Rocky Mountains for practical application.

Proposals to implement direct chemical control on budworm infestations must be supported by biological evaluations, benefit-cost analyses, and environmental analyses. Currently, aerial insecticidal applications for budworm control cost approximately $6.50 per acre for large tracts (possibly 10,000 acres and over). Control costs for smaller tracts or for ground applications may exceed $6.50 per acre. Any insecticidal control project involving the western spruce budworm may require several annual insecticidal applications to achieve protection throughout the duration of the budworm infestation. Considering the timber value of budworm susceptible stands within the Region, it is not likely direct chemical treatment of the budworm can be justified based strictly on timber values. However, high value or high use areas, such as campgounds, picnic grounds, recreation areas, areas with scenic values, Christmas tree production areas, and other areas of high aesthetic values, protection from budworm defoliation may be desirable and feasible. These areas would need to be identified, the impact of defoliation determined, and economic analyses applied by land managers. FI&DM can assist land managers with these analyses.

A do nothing approach to budworm infestations may result in varied amounts of tree deformity, seedling damage, seed destruction, and poor regeneration. Severe and consistent defoliation throughout the duration of the infestation may cause some top-killing and tree mortality. However, the greatest impact of budworm defoliation may be in high use and high value areas, where losses in aesthetic values may be a direct result of budworm infestations.

Currently, the insecticides Sevin and Malathion are registered with the EPA for use against the western spruce budworm. These insecticides are available to all landowners wishing to reduce budworm damage on their lands.

## REFERENCES

McKNIGHT, M. E. et al. 1970. Squential plan for western spruce budworm egg mass surveys in the central and southern Rocky Mountains. USDA For. Serv. Rocky Mtn. For. and Range Exp. Sta. Res. Note RM-174. 8 pp.

TABLE 1 RESULTS OF 1977 WESTERN SPRUCE BUDWORM EGG MASS SURVEY

| Area Surveyed | Number Samples | New Egg Masses | Old Egg Masses | New Egg Masses per Sample | 1977 Defoliation | 1978 Prediction Class | 1978 Prediction Defoliation |
|---|---|---|---|---|---|---|---|
| San Juan National Forest | 120 | 94 | 88 | 0.73 | Light | 2 | Light |
| Rio Grande National Forest | 50 | 0 | 0 | 0.00 | Undetectable | 1 | Undetectable |
| San Isabel National Forest | 90 | 98 | 406 | 1.09 | Heavy | 2 | Light |
| Pike National Forest | 126 | 195 | 755 | 1.55 | Heavy | 3 | Moderate |
| Roosevelt National Forest * | 138 | 255 | 567 | 1.85 | Heavy | 3 | Moderate |

* Includes RMNP and BLM Lands

TABLE 1 (continued) Class limits for the sequential sampling plan for western budworm egg mass surveys [1/]

| Class | New egg masses per 24-inch branch | New egg masses per 1,000 square inches | Defoliation prediction [2/] |
|---|---|---|---|
| 1 | 0.250 or fewer | 1.0 or fewer | undetectable |
| 2 | 0.275 to 1.0 | 1.1 to 4.0 | undetectable in "static" infestations; light in "increasing" infestations |
| 3 | 1.5 to 5.0 | 6.0 to 20.0 | light in "static" infestations; moderate in "increasing" infestations |
| 4 | 5.5 or more | 22.0 or more | moderate or heavy |

1/ adopted from McKnight et. al. 1970.

2/ Percent defoliation of current growth:

| | | |
|---|---|---|
| undetectable | = | 0 to 5 |
| light | = | 5 to 35 |
| moderate | = | 35 to 65 |
| heavy | = | 65 and over |

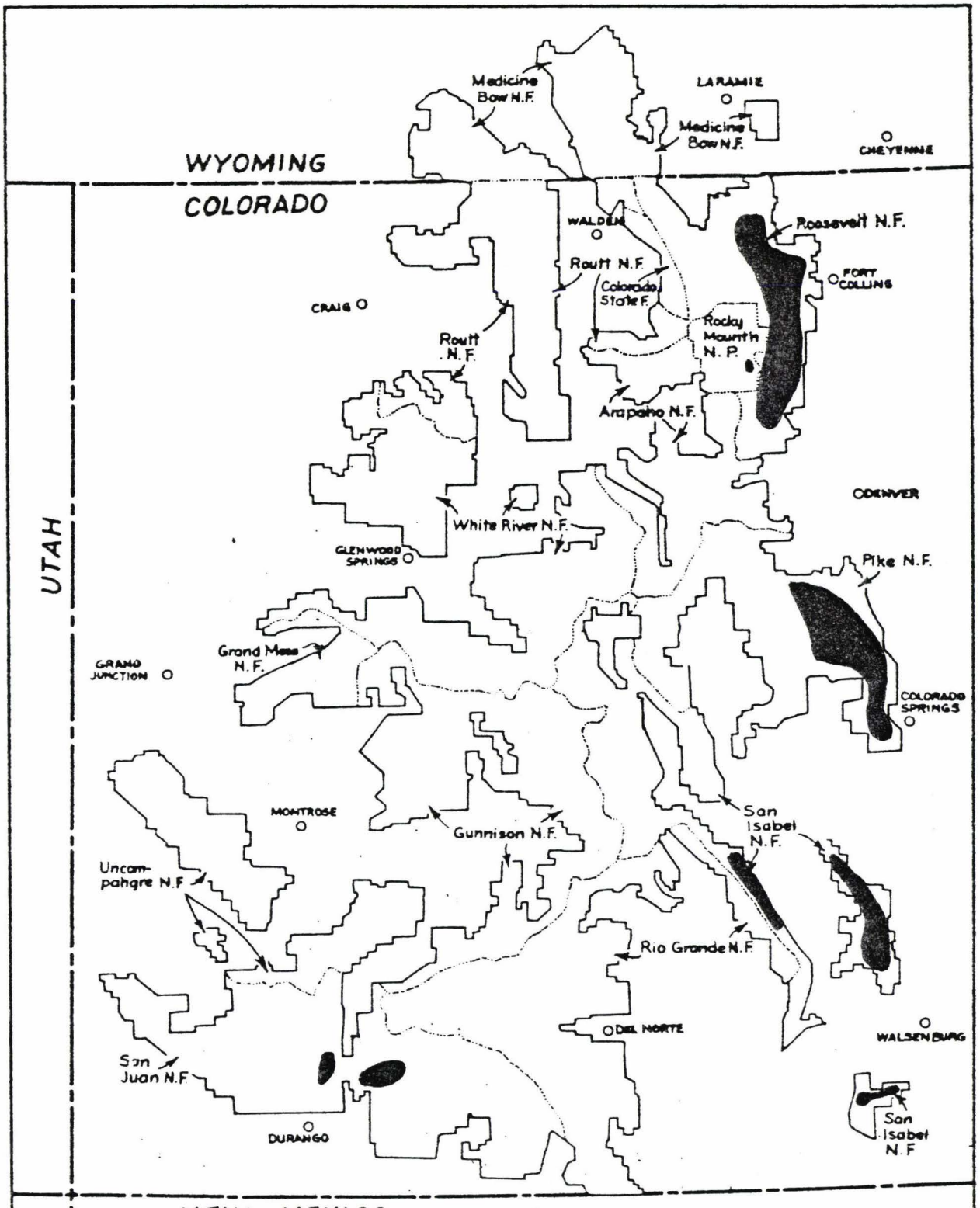


FIGURE 1 WESTERN SRRUCE BUDWORM EGG MASS SURVEYS WERE CONDUCTED IN THE SHADED AREAS DURING 1977.